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How patient-controlled sedation is adopted in clinical practice of sedation for endoscopic retrograde cholangiopancreatography? A prospective study of 1196 cases

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Short title: Sedation for ERCP

ABSTRACT

Objective: Patient controlled sedation (PCS) has been shown to be a valid choice for sedation during endoscopic retrograde cholangiopancreatography (ERCP) in randomized studies. However, large scale studies are lacking.

Material and Methods: A single center, prospective observational study to determine how sedation for ERCP is administered in clinical setting. All 956 patients undergoing 1196 ERCPs in the endoscopy unit of Helsinki University Central Hospital 2012-2013, methods of sedation and adverse events associated with different sedations were recorded.

Results: PCS was attempted a total of 685 times (57%), successful use of PCS was achieved with 526 patients (77% of attempts). PCS device was operated by the anesthesiologist or anesthesia nurse 268 times (22%). PCS was more likely chosen for younger (80.6% for <=60 years vs. 63.8% for >60 years, P<.001) patients and by trainee anesthetists. Anesthesiologist administered propofol sedation was used 240 times (20%). The risk of failure of PCS was increased, if systolic arterial pressure was <90 mmHg, dosage of PCS >17 ml, duration of procedure exceeded 23 min. The risk of failure was lower in patients with primary sclerosing cholangitis (PSC) and if sedation was deeper RASS <=-2. Uneventful PCS was associated with less respiratory and cardiovascular depression than other methods. There were no statistically significant differences in safety profiles with all the methods of sedation.

Conclusions: PCS is readily implemented in clinical practice, is suitable for younger and low risk patients and is associated with less cardiorespiratory adverse effects.

Key Words: Endoscopic Retrograde Cholangiopancreatography (ERCP), Patient-Controlled sedation, Sedation

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Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is one of the most demanding endoscopic procedures that usually cannot be performed without deep sedation or general anesthesia because of substantial procedural discomfort and pain (1-3). There is no agreement on the best method of anesthetic care for ERCP. Traditionally patients undergoing ERCP have been sedated with benzodiazepines and opioids administered by the endoscopists (3). This practice is being replaced by propofol sedation. However, in many countries the presence of an anesthesiologist is required when administering propofol sedation (4).

We have recently shown patient controlled sedation (PCS) with propofol and alfentanil is a feasible and well-accepted method of delivering adequate sedation during ERCP (5). In PCS the patient can adjust the level of sedation at will by taking incremental doses of sedative and analgesic drugs with a remote-control unit connected to the infusion device. PCS is a method which offers individual sedation for each patient and procedure. The method has not been studied only in sedation for ERCP but also in various minimally or moderately invasive and painful procedures such as interventional radiology (6), colonoscopy or change of dressings for more than fifteen years (7-9).

Large scale prospective studies about the use of different methods and PCS for ERCP sedation are lacking. In addition, it is not known how well PCS is adopted in clinical practice. This study was carried out in order to assess the use of PCS and other methods of sedation and their relative safety during ERCP in an endoscopic unit of Meilahti Hospital, a tertiary university clinic, where over 1200 ERCP procedures are performed annually and in which also PCS is available. Our particular interest was also to analyze which factors influence on the choice of the sedation method.

Methods

This study was approved by the institutional Ethics Committee of Helsinki University Central Hospital (Ethics Committee, Department of Surgery, Biomedicum Helsinki 2 C, Tukholmankatu 8 C, PL 705, 00029 HUS, Finland. DNRO 180/13/02/2011) on March 21st, 2012. Informed consent was waived due to non-interventional observational nature of the study by the Ethics Committee.

1228 ERCPs were attempted at the hospital during the 12-month period from March 1st, 2012 to February 28th, 2013. All the adult patients who were treated in the endoscopy unit were included in the study.

The following data of each patient was registered in a prospective manner: age, weight, height, American Society of Anesthesiology physical status classification (ASA), indications, cannulation method, performed procedures, duration of the procedure, sedation details (use of PCS, administration of the sedative by the patient, anesthesiologist or other members of the staff, other methods of sedation, consumption of sedative medication). Heart rate and oxygen saturation (SpO_2) were recorded continuously and non-invasive blood pressure (NIBP) was recorded automatically at 5 min intervals during the procedure. The level of sedation was assessed using the Richmond Agitation-Sedation Scale (RASS) (10) (see Table 1): before the procedure, the deepest level of sedation during the procedure and after the procedure before transfer to recovery room were registered. Use of other medications (vasoactive medication: β-blockers, phenylephrine, naloxone or doxapram, local anesthetic of the pharynx, other medication), the need for mask ventilation, intubation, stopping the procedure for reasons related to anesthesia were recorded. ERCP adverse events (pancreatitis, bleeding, perforation, other), 1- day and 30-day mortality were recorded. Respiratory depression was defined as SpO_2 below 90% and cardiovascular depression was defined as systolic blood

pressure below 90mmHg. In addition, drug related allergic reactions and malfunctions of drug delivery systems, oxygen supply and monitoring devices and other potential sedation related events were registered.

Sedation was administered according to standard clinical practice. An anesthetic nurse and an anesthesiologist were in charge of delivering and monitoring the sedation. For PCS, a syringe-driver with a self-administration unit (Syramed µSP6000; Arcomed AG, Regensdorf, Switzerland) was prepared with propofol and alfentanil to achieve the following concentrations: propofol 8mg/ml and alfentanil 0.06mg/ml. A patient could take a 1 ml dose of this solution when needed, no lock-out time or dose-limit was programmed. Other methods available for sedation were traditional propofol sedation, ketamine, midazolam, fentanyl and alfentanil. The aim was to maintain spontaneous ventilation for each patient. Although PCS was considered the method-of-choice for ERCP, anesthesiologists could freely choose the method of sedation according to their own preferences and the needs of the individual patient.

For the purposes of this study we considered PCS to have been successful, if no other forms of sedation or analgesics were needed apart from initial dose of fentanyl or alfentanil before initiation of the procedure and if an anesthetic nurse or anesthesiologist didn't have to intervene with PCS. If the anesthesia team had to intervene, the method of sedation was considered PCS and anesthesiologist administered sedation (AAS)

Primary endpoints were choice of sedation and successful use of PCS. Secondary endpoints were respiratory and cardiovascular depression and the consumption of sedatives and opioids

The results are reported as medians and interquartile ranges (median [IQR]) or number of patients and percentages. Logistic regression analysis was used to assess the risk of failure. Non-normal data was divided at the median for this analysis. Multivariate analysis was adjusted by age and sex. The variable was included into the multivariate analysis, if p-value was <0.05 in the univariate analysis. Forward stepping was used with $p<0.05$ criteria to include the variable in to the multivariate model. Statistical calculations were generated using IBM SPSS Statistics 19 (International Business Machines Corporation, Endicott, NY, USA).

Results

We excluded 15 ERCPs performed in the operation theatre and 17 ERCPs performed for children and adolescents under 18 years of age. 956 patients with 1196 ERCPs were left in our analysis. Two gastroenterologists performed 253 ERCPs for cases with suspected or diagnosed primary sclerosing cholangitis (PSC) and 4 gastrointestinal surgeons performed 943 ERCP procedures with other indications. All patients were in prone position during the procedure. Characteristics of the 1196 ERCPs are shown in Table 2. Demographics and the cardiorespiratory parameters and drug consumption are shown in Table 3. Sedation levels can be seen in Figure 1.

Median age of the 956 patients was 59.0 [25] years and median BMI 24.8[6.2] kg/m^2, 529(55%) were male and 427(45%) female. The median length of the procedure was 23[19] minutes. There were 299(25%) procedures regarded as emergency ERCPs**.**

Attempted ERCP did not succeed in 33 out of 1196 procedures. In 20 procedures papilla was not reached or found (postoperative state (gastric resection, pancreaticoduodenectomy) (n=5), obstruction proximal to papillary region (n=6), oedema of the descending duodenum (n=8) and one ERCP could not be performed due to patient's allergy to sedatives. In 13 cases papilla was reached but the desired duct couldn't be cannulated.

Methods of Sedation

PCS was attempted 685(57%) times out of the 1196 procedures. Successful use of PCS was achieved in 77% (526 of 685) of PCS attempts i.e. 44% of all procedures. Propofol sedation or anesthesiologist administered PCS solution over PCS was more likely chosen when the

patient was over 60 years old (137/378, 36.2% for >60 vs. 107/551, 19.4% for ≤60 years old, P < .001), was female (116/377, 30.8% for female vs. 128/552, 23.2% for male, P = .012), a surgical patient (223/692, 32.2% for surgical vs. 20/235, 8.5% for gastroenterological patient, P < .001), or had high ASA classification (≥4) (55/92, 59.8% for ≥4 vs. 189/837, 22.6% for <4, P < .001).

Patients with PCS used less propofol (140 (110) mg for PCS vs 189 (216) mg for others, p<0.001) and tolerated the procedure with lower level of sedation (RASS ≤ -2, 153/575, 26.6% for PCS vs 99/207, 47.8% for others, p<0.001) than patients with propofol sedation or anesthesiologist administered PCS solution

The multivariate analysis of PCS success adjusted for age and sex (Table 4) revealed that risk of failure increased if the dosage of PCS solution increased to over 17 ml (propofol 136mg, alfentanil 1,02mg) (OR 1.9, 95% CI 1.2-3.3, p=0.009), duration of procedure increased over 23 min (OR 1.7, 95% CI 1.0-2.7, p=0.042), systolic arterial pressure (SAP) lower that 90mmHg during the procedure (OR 2.2, 95% CI1.1-4.7, p=0.037). The risk of failure was decreased with PSC patients (OR 0.3, 95% CI 0.1-0.5. p<0.0001) and if the level of sedation was (RASS) ≤ -2 (OR 0.2 0.1-0.4, p<0.0001).

One patient was sedated with only ketamine and midazolam (15mg and 7mg, i.v. respectively) due to severe allergies of the patient. The level of sedation was insufficient, and the procedure had to be cancelled.

Two patients received only small doses of opioids. One refused sedative medication and only received fentanyl 0.1mg i.v., the other was a frail old woman and became adequately sedated with a bolus of fentanyl 0.75mg and alfentanil 0.5mg i.v.

Attending anesthesiologist

Attending anesthesiologist was a specialist in 579(48%) of cases and an anesthesiologist in training in 617(52%) of cases. Patients treated by specialists were slightly older than those treated by trainees (61[26] vs. 58[25] years; P=.028). Also, their ASA status was slightly higher (ASA≥3 in 386(67%) vs. 358(58%) (P=.002). Propofol sedation was used more by specialist anesthesiologists (169/467 36.2%, P <.001) than anesthesiologists in training (75/462, 16.2%) whereas PCS was used more by those in training (387/462, 83.8% vs 298/467 63.8%). PCS device operated by the anesthesiologist was not significantly different between trainees and specialists (155/542 vs. 113/411, P=.72).

Anesthesiological Adverse Events

The incidence of respiratory depression was 129:1000 (31 of 240) under conventional propofol sedation, while the incidence of respiratory depression in patients successfully using PCS was 86:1000 (45 of 526). In cases of PCS and AAS, the incidence of respiratory depression nearly doubled to 151:1000 (24 of 159). With all attempts of PCS, the incidence of respiratory depression was 101:1000 (69 of 685). With anesthesiologist or anesthesia nurse operated PCS solution administration the incidence of respiratory depression was 104:1000 (28 of 268). PCS and AAS was associated with respiratory depression (P=.024), when compared to successful use of PCS.

The incidence of cardiovascular depression was 75:1000 (18 of 240) with patients who received propofol sedation. With successful PCS the incidence of cardiovascular depression was 42:1000 (22 of 526). With PCS and AAS, the incidence of cardiovascular depression was 126:1000 (20 of 159). With all attempts at PCS the incidence of cardiovascular depression was 61:1000(42 of 685). With anesthesiologist or anesthesia nurse operated PCS solution

administration the incidence of cardiovascular depression was 97:1000 (26 of 268) of patients. Ephedrine 5-10mg i.v. bolus was used on 10 patients (3 patients using PCS successfully, 3 patients with PCS and AAS, 1 with anesthesiologist administered PCS and 3 using propofol sedation), and phenylephrine 0.1mg i.v. boluses on 13 patients (8 patients with anesthesiologist administered PCS and 2 patients with propofol sedation). One patient receiving anesthesiologist administered PCS was given etilefrine 8mg i.v. Two patients received i.v. epinephrine as part of resuscitation (see next paragraph). Unsuccessful use of PCS was associated with cardiovascular depression (P<.001), when compared to successful use of PCS.

The procedure had to be paused because of anesthesia related reasons (mask ventilation) 15 times: on 10 (1,5 %) patients using PCS, two of which subsequently continued with PCS, eight were converted to anesthesiologist-controlled sedation with PCS solution. 5 patients (2,1%) required mask ventilation under conventional propofol sedation. Mask ventilation was not needed under anesthesiologist administered PCS solution. 3 patients were intubated (one case of air embolism leading to resuscitation, one case of laryngobronchospasm that first was diagnosed as anaphylaxis and one ICU patient with septic cholecystitis, already intubated upon arrival to endoscopy room). No other adverse effects directly related to given sedation were observed.

Degree of difficulty of ERCP

Difficulty of ERCP was assessed using Schutz scale (11). Distribution between the different sedation groups is shown in Table 5.

ERCP adverse events and mortality

There were altogether 99 adverse events in 956 patients. Out of 1196 planned ERCP, in 1176 cases papillary or anastomosis was reached for ERCP. Post-ERCP pancreatitis developed after 32 out of 1176 ERCPs, (2.7%). Fifteen of them were categorized as mild, 13 moderate and 4 severe (12). The rate of post-ERCP pancreatitis in native papilla cases was 14(2.5%). Post-sphincterotomy bleeding occurred after 15 out of 1176 ERCP (1.3%). Four periampullary perforations (0.3%) were treated conservatively. No luminal perforation occurred. Additionally, 12 patients (1%) with guide wire-induced perforations received antibiotics. Twelve patients (1.0%) were treated with antibiotics due to post-ERCP cholangitis. Additionally, 19 miscellaneous adverse events (1.6%; pseudocyst infection, stent migration, stent rupture, peptic ulcer bleeding, air embolism, etc.) and 5 cardiopulmonary adverse events (0.4%, heart attack, pulmonary embolism,) occurred.

Two patients died the same day ERCP was performed (one with air embolism caused by gas insufflation during endoscopy, and one elderly patient with heart attack). Eleven patients died in a week after the procedure (1%) and 30-day mortality was 44 (4.6%). Mortality could not be directly associated with given sedation.

Discussion

The need for ERCP has been estimated to be about 50-100 per 100 000 persons per year and seems to be rising as more and more therapeutic options become available (13, 14). Therefore it is important to determine how these procedures can be performed in a timely manner without compromising patient comfort and, more importantly, safety.

This study has shown, that PCS has a good safety profile during ERCP procedures also in normal clinical setting outside strict research protocols. Patients using PCS consumed less sedatives and tolerated the procedure with lighter level of sedation when compared with anesthesiologist administered PCS solution or conventional propofol sedation which is in accordance with our previous controlled study. This could lead to faster recovery for the patient and facilitate a faster patient stream in the endoscopy unit. However, this was not explored in this study and warrants further studies.

Interestingly, the patients who could successfully self-administer sedative solution with PCS-device were younger and treated by a trainee-anesthesiologist than those who did not. In order to use PCS successfully the patient needs to be taught how to use it. It could be that the trainees gave the patients more thorough information on the method and thus facilitated the success. The attending anesthesiologist was free to choose the method of sedation which he or she provided. The investigators made no effort to influence this choice. Also, the patients were free to choose whether they wanted to use PCS or not, provided that they were capable of making the decision. Previous studies have provided evidence that PCS is also suitable for elderly patients (16-18), in this study there was no significant effect of age on PCS success

There was a major discrepancy in the success rate of PCS in patients with other indications when compared with PSC patients. This is at least in part due to the procedural technical differences. Higher pressure is used in biliary or pancreatic dilatations of other patients than in patients with sclerosing cholangitis, thus making the procedure considerably more painful. Also, the gastroenterological patients with sclerosing cholangitis were significantly younger and healthier as described by the ASA physical status. We believe that younger patients were encouraged to the use of PCS as opposed to other forms of sedation.

Although there were no other statistically significant differences in respiratory or cardiovascular depression between the groups in our study, there was a trend toward fewer adverse events with PCS as opposed to conventional propofol sedation, the incidence of mask ventilation was 15:1000 and 21:1000 in patients sedated with PCS and anesthesiologist administered propofol, respectively in the current study. We hypothesize that this may be related either to the solution used in PCS or to the lack of patients´ training of using PCS prior the procedure. The present combination of propofol and alfentanil appeared safe in our previous study (5) but obviously there is a need for further studies about the most appropriate composition of sedatives and opioids in the PCS-solution. Patient education is also of paramount importance in order for PCS to be successful, since the patient is the one administering the sedation. Also the staff needs to be properly informed on the method in order to be able to counsel the patient in the use of PCS. Some anesthesiologists or nurses received only written instructions about the method. Interestingly mask ventilation was not needed at all when PCS solution was administered by an anesthesiologist while mask ventilation was required occasionally when traditional propofol sedation was used, yet traditional propofol sedation is the method anesthesiologists are most familiar with. The reason for this remains unclear. Regarding the overall cardiovascular safety of PCS, our

findings are in concurrence with previous studies on the safety of PCS during ERCP (5, 15, 19).

One of the advances of the PCS is that it can be easily converted to a nurse or an anesthesiologist administered administration of sedation simply by taking control of the self-administration unit. This occurred in 132 of the procedures in the present study. Nurse administered propofol sedation has been shown to be safe and effective for ERCP and variety of other procedures (20-23). While not the purpose or within the scope of this study, one could surmise that PCS could be delivered by trained nurse specialists, at least to younger and healthier patients. Naturally a nurse specialist would have to be trained to manage sedation related adverse events such as cardiorespiratory depression even though adverse event rates for different methods of sedation were similar and reasonably low and serious adverse events were rare and not associated with any particular method of sedation

PCS has been available in our institution for several years and has been shown in several studies – even ones performed in our own institution (15, 19) - to be a valid choice for sedating ERCP patients. Even so, according to the survey we made, traditional propofol sedation was more likely chosen by our anesthesiologists, both trainees and specialists. It has been previously shown that changing doctors' clinical routines with evidence based medicine is difficult (24) and needs an active approach (25). While there still isn't a consensus on what type of anesthetic care is the best for ERCP, the small number of anesthesiologists using PCS does raise the question, whether more education on the subject would be warranted.

This study does have its limitations. It is a single center study so the findings may not be universally applicable. However, there is a constantly changing pool of senior anesthesiologists and trainees in anesthesiology administering sedation for ERCP procedures. Another drawback is, that we did not record why propofol sedation or anesthesiologist

administered PCS-solution was chosen over PCS by the anesthesiologist, even though PCS was considered as the method-of-choice. This was a conscious decision on our part as to not influence the decision-making process and thus make PCS more likely to have been chosen than it otherwise would have been. There is also the risk of selection bias in this study due to the lack of randomization of the different groups. Further randomized prospective studies are undoubtedly needed to identify the most optimal patients for PCS. Finally, we didn't investigate patient preferences or satisfaction with different methods of sedation even though this is an important question when it comes to choosing the method of sedation. Our previous studies (5, 15, 19) and clinical experience have shown however, that patients are usually highly satisfied with PCS and would choose the same method of sedation again, if needed.

In conclusion, both anesthesiologist administered sedation and PCS were found to be effective and safe during ERCP. Successful use of PCS leads to lower consumption of sedatives and lighter level of sedation, which may facilitate faster patient recovery.

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References

1. Kapoor H: Anaesthesia for endoscopic retrograde cholangiopancreatography. Acta Anaesthesiol. Scand., 2011, 55, 8, 918-926

2. Jeurnink SM: The burden of endoscopic retrograde cholangiopancreatography (**ERCP**) performed with the patient under conscious sedation. Surgical Endoscopy 26(8):2213-9, 2012 Aug

3. Garewal D, Powell S, Milan SJ, Nordmeyer J, Waikar P: Sedative techniques for endoscopic retrograde cholangiopancreatography. Cochrane Database of Systematic Reviews 6:CD007274, 2012

4. Perel, A: Non-anaesthesiologists should not be allowed to administer propofol for procedural sedation: a Consensus Statement of 21 European National Societies of Anaesthesia. Eur J Anaesthesiol 2011;28:580–584

5. Mazanikov M, Udd M , Kylanpaa L, Mustonen H, Lindstrom O, Halttunen J, et al. R: Patient-controlled sedation for ERCP: a randomized double-blind comparison of alfentanil and remifentanil. Endoscopy 44(5):487-92, 2012 May

6. Herrick,Ian A.; Gelb,Adrian W.; Tseng,Phillip S.; Kirkby,Joyce: Patient-Controlled Sedation Using Propofol During Interventional Neuroradiologic Procedures. J.Neurosurg.Anesthesiol., 1997, 9, 3, 237-241

7. Crepeau T, Poincloux L, Bonny C, Lighetto S, Jaffeux P, Artigue F, et al.: Significance of patient-controlled sedation during colonoscopy. Results from a prospective randomized controlled study. Gastroenterol Clin Biol 2005; 29: 1090-6

8. A. Nilsson, I. Steinvall, Z. Bak *et al.* Patient controlled sedation using a standard protocol for dressing changes in burns: patients' preference, procedural details and a preliminary safety evaluation, Burns, 34 (2008), 929–934

9. Mandel,Jeff E.; Lichtenstein,Gary R.; Metz,David C.; Ginsberg,Gregory G.; Kochman,Michael L. A prospective, randomized, comparative trial evaluating respiratory depression during patient-controlled versus anesthesiologist-administered propofol-remifentanil sedation for elective colonoscopy. Gastrointest.Endosc., 2010, 72, 1, 112-117

10. Curtis N. Sessler, Mark S. Gosnell, Mary Jo Grap, Gretchen M. Brophy, Pam V. O'Neal, Kimberly A. Keane, et al.: The Richmond Agitation–Sedation Scale – Validity and Reliability in Adult Intensive Care Unit Patients, Journal of Respiratory and Critical Care Medicine, Vol. 166, No. 10 (2002), 1338-1344.

11. Schutz SM. Grading the Degree of Difficulty of ERCP Procedures. Gastroenterology & Hepatology. 2011;7(10):674-676.

12. Cotton PB, Lehman G, Vennes J, et al. Endoscopic sphincterotomy complications and their management: an attempt at consensus. Gastrointest Endosc 1991;37:383-93.

13. Gear,M.W.; Dent,N.A.; Colin-Jones,D.G.; Lennard-Jones,J.H.; Colley,J.R., Future needs for ERCP: incidence of conditions leading to bile duct obstruction and requirements for diagnostic and therapeutic biliary procedures. Gut, 1990, 31, 10, 1150-1155.

14. Coelho-Prabhu,N.; Shah,N.D.; Van Houten,H.; Kamath,P.S.; Baron,T.H.: Endoscopic retrograde cholangiopancreatography: utilisation and outcomes in a 10-year population-based cohort. BMJ Open, 2013, 3, 5

15. Mazanikov,M.; Udd,M.; Kylanpaa,L.; Lindstrom,O.; Aho,P.; et al.: Patient-controlled sedation with propofol and remifentanil for ERCP: a randomized, controlled study. Gastrointest.Endosc., 2011, 73, 2, 260-266

16. Herrick,I.A.; Gelb,A.W.; Nichols,B.; Kirkby,J.: Patient-controlled propofol sedation for elderly patients: safety and patient attitude toward control. Can.J.Anaesth., 1996, 43, 10, 1014-1018

17. Lee,D.W.; Chan,A.C.; Sze,T.S.; Ko,C.W.; Poon,C.M.; Chan,K.C.; et al..: Patient-controlled sedation versus intravenous sedation for colonoscopy in elderly patients: a prospective randomized controlled trial. Gastrointest.Endosc., 2002, 56, 5, 629-632

18. Yun,M.J.; Oh,A.Y.; Kim,K.O.; Kim,Y.H.: Patient-controlled sedation vs. anaesthetic nurse-controlled sedation for cataract surgery in elderly patients. Int.J.Clin.Pract., 2008, 62, 5, 776-780

19. Mazanikov,M.; Udd,M.; Kylanpaa,L.; Mustonen,H.; Lindstrom,O.; Farkkila,M.; et al..: A randomized comparison of target-controlled propofol infusion and patient-controlled sedation during ERCP. Endoscopy, 2013, 45, 11, 915-919

20. Jang,S.Y.; Park,H.G.; Jung,M.K.; Cho,C.M.; Park,S.Y.; Jeon,S.W.; et al.: Bispectral index monitoring as an adjunct to nurse-administered combined sedation during endoscopic retrograde cholangiopancreatography. World J.Gastroenterol., 2012, 18, 43, 6284-6289

21. Jensen,J.T.; Banning,A.M.; Clementsen,P.; Hammering,A.; Hornslet,P.; Horsted,T.; et al..: Nurse administered propofol sedation for pulmonary endoscopies requires a specific protocol. Dan.Med.J., 2012, 59, 8, A4467

22. Kawa,C.; Stewart,J.; Hilden,K.; Adler,D.G.; Tietze,C.; Bromberg,M.B.; et al..: A retrospective study of nurse-assisted propofol sedation in patients with amyotrophic lateral sclerosis undergoing percutaneous endoscopic gastrostomy. Nutr.Clin.Pract., 2012, 27, 4, 540-544

23. Slagelse,C.; Vilmann,P.; Hornslet,P.; Hammering,A.; Mantoni,T.: Nurse-administered propofol sedation for gastrointestinal endoscopic procedures: first Nordic results from implementation of a structured training program. Scand.J.Gastroenterol., 2011, 46, 12, 1503-1509

24. Shuval,Kerem; Berkovits,Eldar; Netzer,Doron; Hekselman,Igal; Linn,Shai; Brezis,Mayer; et al.: Evaluating the impact of an evidence-based medicine educational intervention on primary care doctors? Attitudes, knowledge and clinical behaviour: a controlled trial and before and after study. J.Eval.Clin.Pract., 2007, 13, 4, 581-598

25. Onion,C W.; Bartzokas,C A.: Changing attitudes to infection management in primary care: a controlled trial of active versus passive guideline implementation strategies. Family Practice, 1998, 15, 2, 99-104

Tables

Table 1. Richmond Agitation Sedation Scale

-5	Unarousable, no response to voice, physical stimulation or pain
-4	Deep sedation, responds only to pain (such as bile duct dilatation)
-3	Moderate sedation, responds to physical stimulation (such as shaking, manipulation of the gastroscope)
-2	Light sedation, responds to repeated loud voice, eyes open <10 seconds
-1	drowsy, not fully alert, but has sustained awakening (eye-opening/eye contact) to voice (>10 seconds)
0	Alert and calm
1	Restless, anxious but movements not aggressive, vigorous
2	Agitated, frequent non-purposeful movement, fights the procedure
3	very agitated, pulls or removes catheters; aggressive
4	Combative, violent, immediate danger to staff

Table 2. ASA class and number of attempted ERCPs performed to 956 adult patients attending ERCPs in Meilahti endoscopy unit during March 1st, 2012 to February 28th, 2013

ASA class	Number (%) of patients n = 956
ASA I	31(3)
ASA II	347(36)
ASA III	450(47)
ASA IV-V	128(13)
Number of ERCP:s performed	
1	787 (82)
2	116(12)
3	42(4)
≥4	11(2)

ASA= American Society of Anesthesiology physical status classification; ERCP= endoscopic retrograde cholangiopancreatography

Table 3. Demographics, drug consumption and incidence of hypoxemia and hypotension of the patients

	PCS n=526	PCS + AAS n=159	PCS administered by Anesthesiologist /nurse n=268	AAS n=240
Duration; minutes (IQR)	22(17)	26 (27)	22 (21)	23 (19)
age; years(IQR)	53 (24)	58 (22)	69 (28)	63(18)
ASA class (%)	I: 22 (4.2) II: 232 (44.1) III:247 (47.0) IV: 25 (4.8) V: 0	I: 4 (2.5) II: 63 (39.6) III:80 (50.3) IV: 12 (7.5) V: 0	I: 4 (1.5) II: 50 (18.7) III:144 (53.7) IV: 69 (25.7) V: 1 (0.4)	I: 5 (2.1) II: 71 (29.6) III:110 (45.8) IV: 53 (22.1) V: 1 (0.4)
BMI kg/m^2 (IQR)	25.2 (6.0)	24.3 (5.7)	24.5 (6,1)	24.8 (6.7)
drug consumption:				
PCS solution; ml (IQR)	17 (14)	21 (15)	13 (12)	-
Propofol infusion or boluses:				
Number of times used	-	30	14	240
Dosage of propofol infusion and/or boluses; mg (IQR)	-	80 (150)	80 (50)	195 (203)
Total propofol dosage including PCS; mg (IQR)	133 (112)	176 (127)	104 (104)	195 (203)
Fentanyl				
number of times used	453	138	224	184
dosage; mg (IQR)	0.05 (0)	0.05 (0)	0.05 (0)	0.05 (0.05)
Alfentanil (in addition to PCS solution)				
Number of times used	2	11	7	50
dosage; mg (IQR)	0.75 (0.25)	0.5 (0)	0.5 (0.05)	0.5 (0.5)
total Alfentanil dosage mg (IQR)	1.0 (0.84)	1.29 (0.89)	0.78 (0.72)	0.5 (0.5)
Ketamine				
Number of times used	-	20	21	8
dosage; mg (IQR)	-	12.5 (7.5)	16.3 (10.0)	22.5 (8.8)

Hypoxemia; incidence	86:1000	151:1000	104:1000	129:1000
Hypotension; incidence	42:1000	126:1000	97:1000	75:1000

PCS = Patient Controlled Sedation, PCS + AAS = Patient controlled Sedation and Anesthesiologist Administered Sedation, AAS= Anesthesiologist Administered Sedation, IQR = Inter Quartile Range, ASA class = American Society of Anesthesiology physical status classification, BMI = Body Mass Index, SpO2 = Peripheral Oxygen saturation, Hypoxemia = SpO2 <90%, Hypotension = Systolic arterial pressure <90mmHg

Table 4 Univariate and multivariate logistic regression analysis of PCS success

		95% CI		
Univariate	ODDS	lower	Upper	p
Age >60 years	1.5	1.0	2.1	0.037
Gender male	1.3	0.9	1.9	0.158
Dosage of PCS > 17 ml	1.9	1.3	2.7	0.001
Duration of procedure >23 min	1.8	1.2	2.6	0.002
RASS <= -2	0.3	0.2	0.4	0.000
Systolic arterial pressure (SAP) < 90mmHg	3.3	1.7	6.2	0.000
Bile duct stricture	1.6	1.1	2.3	0.015
Primary sclerosing cholangitis	0.5	0.3	0.7	0.000
Common bile duct stone	0.8	0.5	1.4	0.444
Post laparoscopic cholecystectomy	0.9	0.3	2.7	0.819
Post liver transplant	0.5	0.1	1.6	0.216
Chronic pancreatitis	1.6	1.0	2.4	0.047
Acute pancreatitis	0.9	0.2	3.3	0.873
Pancreatic duct stone	1.3	0.7	2.4	0.369
Multivariate				
Age >60 years	1.2	0.8	1.9	0.415
Gender male	1.4	0.9	2.1	0.165
Dosage of PCS > 17 ml	2.0	1.2	3.3	0.009
Duration of procedure >23 min	1.7	1.0	2.7	0.042
RASS <= -2	0.2	0.1	0.4	0.000
Systolic arterial pressure (SAP) < 90mmHg	2.2	1.1	4.7	0.037
Primary sclerosing cholangitis	0.3	0.1	0.5	0.000

Table 5. Degree of Difficulty of ERCP

Degree of difficulty: degree of difficulty of ERCP according to Schutz scale (11)

Method of Sedation			degree of difficulty				Total
			1	2	3	4	
	PCS successful	Count	210	158	136	22	526
		% within sedation group	39,9%	30,0%	25,9%	4,2%	100,0%
		% within degree of difficulty	63,3%	32,6%	41,8%	42,3%	44,1%
		% of Total	17,6%	13,2%	11,4%	1,8%	44,1%
	PCS Anesthetist/Nurse	Count	43	134	79	12	268
		% within sedation group	16,0%	50,0%	29,5%	4,5%	100,0%
		% within degree of difficulty	13,0%	27,7%	24,3%	23,1%	22,5%
		% of Total	3,6%	11,2%	6,6%	1,0%	22,5%
	PCS unsuccessful	Count	45	49	57	8	159
		% within sedation group	28,3%	30,8%	35,8%	5,0%	100,0%
		% within degree of difficulty	13,6%	10,1%	17,5%	15,4%	13,3%
		% of Total	3,8%	4,1%	4,8%	0,7%	13,3%
	Propofol sedation	Count	34	143	53	10	240
		% within sedation group	14,2%	59,6%	22,1%	4,2%	100,0%
		% within degree of difficulty	10,2%	29,5%	16,3%	19,2%	20,1%
		% of Total	2,8%	12,0%	4,4%	0,8%	20,1%
Total		Count	332	484	325	52	1193
		% within degree of difficulty	100,0%	100,0%	100,0%	100,0%	100,0%
		% of Total	27,8%	40,6%	27,2%	4,4%	100,0%

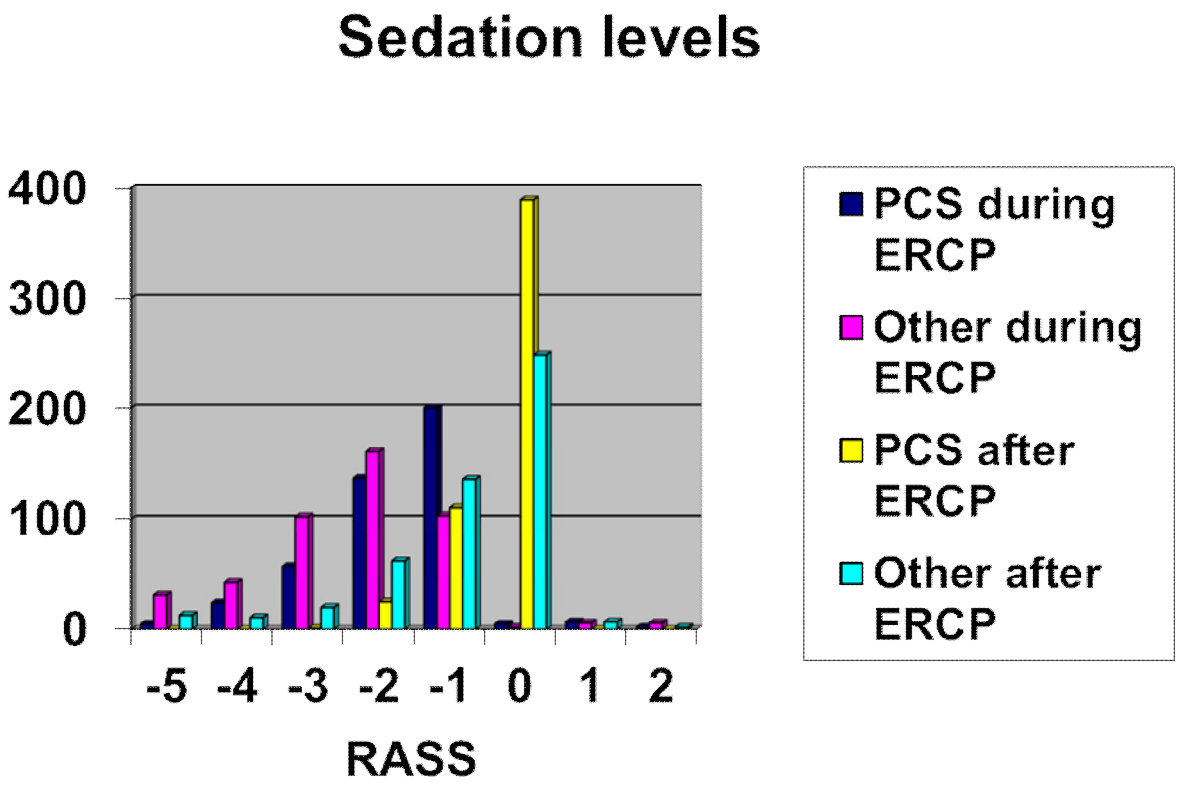
Table 6. Results of the survey on anesthesiologists' attitudes regarding sedation

	Specialists (n=16)	Trainees (n=8)
Sedations/month, mean(SD)	2(1,3)	3(1,0)
PCS method of choice	6 (38%)	1 (13%)
Propofol sedation method of choice	11 (69%)	7 (88%)
Perceived problems with PCS:		
Uneven anesthesia	8 (50%)	2 (25%)
Restlessness/anxiety	4 (25%)	3 (38%)
Lack of co-operation	9 (56%)	4 (50%)
Respiratory depression	2 (13%)	0
Slow onset of sedation after bolus	0	1 (13%)
PCS not suitable for patients with:		
Dementia/lowered cognitive capabilities/old age	5 (31%)	3 (38%)
ASA 4-5	6 (38%)	
Alcoholism/drug abuse	4 (25%)	1 (13%)
Risk of aspiration	2 (13%)	
Chronic pain	1 (6%)	1 (13%)
Could nurses be able to sedate ERCP patients alone		
Never under any circumstances	2 (13%)	1 (13%)
Yes, if adequate intructions and guidelines are provided	5 (31%)	1 (13%)
Yes, if an anesthesiologists is immediately available	12 (75%)	6 (75%)
Yes, but only with PCS	2 (13%)	2 (25%)

PCS = Patient Controlled Sedation, ASA class = American Society of Anesthesiology physical status classification, ERCP = Endoscopic Retrograde Cholangiopancreatography

Figures

Figure 1. Sedation levels



PCS during ERCP: Lowest RASS score of patients using PCS during the procedure

PCS after ERCP: Lowest RASS score of patients using PCS after the procedure

Other during ERCP: Lowest RASS score of anesthesiologist administered PCS solution or anesthesiologist administered propofol sedation during the procedure.

Other after ERCP: Lowest RASS score of anesthesiologist administered PCS solution or anesthesiologist administered propofol sedation after the procedure.

Number of patients is shown on the Y-axis.

RASS: Richmond Agitation-Sedation Scale